A lab’s strategy to reduce errors depends on automation

By Denise L. Uettwiller-Geiger, PhD, DLM(ASCP)

Six years ago, the Institute of Medicine (IOM) issued its report To Err is Human: Building a Safer Health System. The monograph’s conclusion was so startling that one of its statistics still reverberates throughout healthcare today: Up to 98,000 Americans die annually from medical errors. In terms of number of deaths, medical errors represent a far greater threat to Americans than traffic accidents.

The medical laboratory plays a major role in helping to prevent medical-error tragedies. Most of the information that physicians depend upon for diagnosis and treatment of their patients — as the Joint Commission on Accreditation of Healthcare Organizations or JCAHO has emphasized — originates in the lab. Appropriate diagnosis and treatment, therefore, depends upon results that are not only accurate but also that are delivered immediately.

In fact, the IOM report identified “delay in diagnosis” as one of the most critical forms of medical error. And delayed treatment is the downstream result of a delayed diagnosis. For patients whose conditions are life threatening, faster-than-normal test turnaround time (TAT) can mean the difference between living and dying.

Yet, even as the lab’s central role in medical decision making becomes more widely recognized, other trends in healthcare increase the likelihood that laboratory errors will occur. For example, cost constraints — as well as fatigue and/or stress caused by the persistent labor shortage combined with increasing workloads — can lead to testing errors and delays.

The solution to these problems is obvious and relatively straightforward:

- First, labs need to make their processes as efficient as possible in order to optimize their labor resources without increasing work stress;
- Second, with automation, labs can minimize the chances for human errors and speed delivery of results; and
- Third, automation needs to be linked with information technology and systems that can alert the lab — and, ultimately, physicians — to critical test results that indicate potentially life-threatening situations.

The best of today’s automation systems can run virtually error-free almost all of the routine tasks in a lab, and greatly expand the lab’s testing capacity and productivity. Laboratory automation and information systems (LAS/LIS) — including sophisticated data-management software — provide essential solutions to the challenge of rapidly providing physicians with critical test values. Given the accessibility of advanced technology today, all of these steps are cost-effective, even for community hospital labs like John T. Mather Memorial Hospital (Mather), a 248-bed community hospital, in Port Jefferson, NY.

Process redesign

Mather’s lab, which performs 1.6 million tests per year, has realized dramatic reductions in error potential with a long-term strategy. Based on its experiences, the hospital’s laboratory administrators believe that other labs can yield similar benefits as a result of advanced technology, regardless of their size or testing volume.

As a small community hospital, Mather’s acquisition of a large customized automation system was not feasible 10 years ago; such systems were generally considered only for large institutions. Although improvements through automation and data management were not available to them in 1995, the hospital’s laboratory personnel were able to make significant progress towards error reduction. It was at that time Mather began streamlining its processes as part of a project to create

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Mather's error-reduction efforts formed the core of its quality-improvement initiative. Applying an industrial “maxim” — that reducing the number of human-performed steps also reduces opportunities for errors — meant using bar-code labeling for sample tubes and electronic test ordering. While the process-redesign efforts reduced TAT, improved test-result reporting, and reduced opportunities for medical errors, the staff knew that even more significant improvements could be made.

Laboratory space renovation and redesign allowed the integration of processes, technology, and personnel for optimal utilization. For example, efficiency was improved by grouping chemistry, immunoassay, and hematology sample processing in one centralized area of the lab. Integration of these disciplines and processes helped eliminate unnecessary steps. Eventually, the lab redesign was expanded to include an integrated automation and data-management system. That expansion had a synergistic effect on Mather’s process redesign.

One of the benefits of process redesign and automation/data management is that the same efficiencies that reduce errors also save money and improve service. For example, by speeding results to physicians, the lab enables them to make more rapid clinical decisions. The lab staff recognized that process redesign was not a separate initiative from automating the lab at some future point. Process redesign was viewed as a necessary preparatory stage for automation, which should add efficiency to an already optimized workflow — not compensate for an inefficient one.

Automation and IT help improve clinical care

Essentially, many of the same advantages gained through process redesign are also advantages of lab automation and advanced information systems. Mather’s combined automation and data-management system achieves advantages that would be impossible even with optimized human processes. It eliminates the variability that is inevitable with manually performed work and produces a TAT that is not only faster on average but also accurate and more predictable.

Consider automation’s impact on the pre-analytic phase of testing. When automating this phase — as Mather did — the “human factor” was removed from virtually all of the most error-prone functions in the lab. Some of these tasks involved the proper matching of sample to patient, which is critical to patient safety. Automating the pre-analytical process also entailed process improvements in other areas. For example, Mather’s automation line performs not only sample login, sorting, and cap-removal but also centrifugation. The lab has eliminated outliers, providing physicians with consistent, reliable test results in a standardized time frame.

Data-management software’s impact

Many of the greatest error-reducing benefits of the hospital’s integrated laboratory delivery system come from data-management software that interfaces between the lab instruments and the LIS:

**Focus on critical results.** The data-management software notifies users of critical results with pop-up screens according
to rules the user has entered into the system. Besides alerting operators to critical results that have occurred, this management system informs technologists of the proper protocol to follow, which speeds response time for these medical emergencies. At Mather, physicians’ names and phone numbers have been entered into the software, so that doctors can be notified immediately when critical results for outpatients appear. In addition, this feature is used to identify subpopulations of patients who may require further testing. The rules-based alerts mean that decisions are made consistently in line with standard lab protocol and sound clinical practice. They also help ensure that no critical result will be overlooked.

**TAT.** The efficiencies created by an integrated automation and data-management system add up to dramatically improved TAT that is also consistently and predictably fast. For example, Mather’s TAT for the cardiac marker troponin I is now 42 minutes from the time of receipt in the laboratory to release to the emergency department. This is 37 minutes less than in the lab’s pre-automation days, a 47% improvement. A plan to add additional immunoassay instruments to the automation line should further improve TAT.

**Autovalidation and delta checking.** Mather’s data-management system handles the automatic validation and reporting of normal results, according to user-defined rules. This reduces error potential in several ways. First, a huge volume of work that would otherwise be reviewed by technologists is shifted to the software. About 75% to 80% of the lab’s test volume is autovalidated. If humans did that work instead, fatigue alone would almost inevitably lead to errors. Second, the system frees technologists to devote more focus to abnormal results that must be validated manually. Third, the speed of the autovalidation process is a major factor in improving TAT. Besides autovalidation, the system also performs delta checking, which helps identify erroneous results and helps laboratorians make better decisions about the disposition of results.

**Global view.** When Mather links its hematology and chemistry analyzers to the data-management network, as planned, the software will enable lab staff to get a more global view of the patient than if hematology and chemistry results were viewed separately. Similar features and benefits are also built into the automated analyzers themselves. For instance, the lab’s chemistry analyzers perform integrity checks on samples. Prior to this instrument technology, technologists relied on sight alone to identify hemolysis or lipemia in a sample — an obvious opportunity for errors of judgment.

Error reduction has been the focus of many lab administrators ever since *To Err is Human* was published, and properly so. But good intentions without effective action are not sufficient. Training, proper staffing, and good work conditions all contribute to higher quality results from the lab and represent a good starting point. Process redesign that reduces the number of tasks is another important step. By completely integrating those efforts with state-of-the-art automation and information systems, lab administrators can make additional contributions to error reduction and to improved patient safety.

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